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REPORT NO. KZ 3754

PURPOSE

It is the purpose of this report to establish limits for discarding solutions with a low concentration of "T" on the grounds that

1. It is uneconomical to spend more for recovery than the material is worth, and
2. That the amount of material ~~not recovered~~ is only a small portion of that available for recovery.

PRODUCTION COSTS

It has been conservatively estimated that crude feed costs $5.90 per pound of "T", and that "T" enriched to 30% "X" costs $8,000 per pound "T". The curve relating cost of "T" to enrichment has been prepared on a linear basis because it is assumed to be conservative. If cost vs. enrichment is an exponential curve, then cost figures below 30% enrichment would probably be somewhat more than the linear curve. Beyond 30% enrichment the cost would probably be less than that given by the straight line.

RECOVERY COST

Cost of recovery figures are taken from a report to Mr. L. L. Anthony, Jr. by Mr. J. H. Julien, October 30, 1946.

They are:

Class	A	B	C	D	E
Recovery cost, dollars per gallon	4.05	3.23	1.64	1.39	1.26

The concentration of "X" in each class is based on a Special Hazard Report of Mr. W. C. Beard, Jr. dated July 17, 1946.

Class	A	B	C	D	E
Upper limit, mol %	1.04	5.39	14.41	30.18	60.00
Upper limit, wt. %	1.027	5.326	14.254	29.914	59.695

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Carbide and Carbon Chemicals Corporation, Operating Contractor for the U.S. Atomic Energy Commission.

RECOMMENDED LIMITS

The following table shows at which concentrations the value of "T" recovered from waste solutions equals the cost of recovery. Below these concentrations, the cost of recovery exceeds the value of the material recovered. It is quite probable that these figures are very conservative.

Class of Material	Wt. % "X" in "T"	Grams "T" per Liter
A	1.027	5.427
	1.027	5.427
	2.00	4.268
B	3.00	3.077
	4.00	1.886
	5.00	.694
	5.326	.306
	5.326	.306
	6.00	.287
	8.00	.230
C	10.00	.174
	12.00	.117
	14.00	.0603
	14.254	.0531
	14.254	.0531
	15.00	.0516
D	20.00	.0413
	25.00	.0310
	29.914	.0209
	29.914	.0209
	30.00	.0209
	35.00	.0189
	40.00	.0170
E	45.00	.0151
	50.00	.0131
	55.00	.0112
	59.695	.0094

It is important to note that the successful application of this table depends on accurate analyses in very low concentration ranges (.009 g/l).

ESTIMATED LOSSES

The present estimate of "T" inventory is

	# Material	#"T"
Alumina Traps	20,000	634
Carbon and Carbon - alumina traps	250,000	21,000
Liquid Media	250,000	~~615~~

The amount of "T" in liquids is about 3% of the "T" available for recovery from all types of contaminated wastes. The maximum amount of "X" in all classes of liquids is 23 pounds. It is more reasonable to assume that only half this amount is present in all liquid media. With the further assumption that all class A and half of class B solutions are discarded, of 15 pounds of "X" available, 4 pounds would not be recovered. This also amounts to discarding "X" to the value of $114,230 from a total value of $513,600. worth of "X".

ESTIMATED DISTRIBUTION OF "T" IN LIQUID MEDIA
Based on October 1, 1946 Inventory

Class	Pounds "T"	Value, Dollars Per Pound	Total Value	Gallons Solution	Recovery Cost Per Gallon	Total Recovery Cost
A	458.20	89.44	40,981.41	9276	4.05	37,567.80
B	115.97	1,283.21	148,494.46	10,388	3.23	33,553.24
C	12.64	3,700.84	46,778.62	3676	1.64	6,028.64
D	25.10	7,976.52	200,210.65	4900	1.39	6,811.00
E	4.85	16,107.68	78,122.25	760	1.26	957.60

In the table just given, class M solutions were apportioned to the classified solutions. It was assumed that each drum held 40 gallons, instead of the maximum 55 gallons.

ESTIMATED "X" DISTRIBUTION
Based on October 1, 1946 Inventory

Class	Pounds "T"	Pounds "X"
A	458.20	~~2.36~~
B	115.97	3.68
C	12.64	1.24
D	25.10	5.54
E	4.85	2.17
	616.76	14.99

METHODS OF CALCULATION

Cost Equation

Two points were used to calculate the cost vs. enrichment curve. At .00721 wt. % "X" the cost was taken as $5.90 per pound "T". At .3000 wt. % "X" the cost was taken as $8000 per pound "T". This yielded the equation

$$Y = 27{,}303.19\,x - 190.96$$

Where Y = Cost "T" in dollars per pound
X = Conc. "X" in "T" (X = .01 is 1%)

SETTING CONCENTRATION LIMITS FOR EACH CLASS

1. List class of material
2. List maximum mol.% "X" in each class
3. Convert maximum mol.% "X" in each class to wt.%
4. List maximum cost of "T" in dollars per pound for each class
5. List cost of recovery in dollars per gallon
6. Compute pounds of "T" per gallon such that value of material recovered equals cost of recovery
7. Compute equivalent grams per liter.

Converting Mol.% to wt. %

$$\frac{\frac{\text{Wt. X in \#}}{235}}{\frac{\text{Wt. X in \#}}{235} + \frac{\text{Wt. 238 in \#}}{238}} = \text{Mol.\%}$$

Example: 1.04 Mol.%

$$\frac{\frac{\text{Wt. X}}{235} = .0104}{.0104 + .9896} = .0104$$

$$\frac{\text{Wt. 238}}{238} = .9896$$

Wt. 238 = 238 (.9896) = 2.4440 #
Wt. 235 = 235 (.0104) = 235.5248 #
237.9688 #

$$\frac{2.4440}{237.9688} = 1.027 \text{ wt.\%}$$

Step 6

Cost of recovery = Value of "T"

Example, Class A

$4.05/gallon = $89.44/pound x no. of pounds

$$\text{No. of pounds} = \frac{4.05}{89.44} = 4.528 \times 10^{-2} \text{ in each gallon}$$

[redacted]

Step 7

$$\frac{\text{Pounds}}{\text{Gallon}} = \frac{453.59 \text{ Grams}}{3.785 \text{ Liter}} = 119.839 \frac{\text{Grams}}{\text{Liter}}$$

$$119.839 \frac{\text{Grams}}{\text{Liter}} \times \frac{10^3}{10^3} = 119{,}839 \frac{\text{Grams}}{\text{Million Grams}}$$

Example, Class A

$$4.528 \times 10^{-2} \times 119{,}839 = 5{,}427 \frac{\text{Grams}}{1000 \text{ Liters}}$$

Intermediate points in each class were computed on a linear basis.

VALUES USED TO COMPUTE "X" ON P 3

Class	Median wt. % X
A	~~.514~~
B	3.177
C	9.79
D	22.084
E	44.805

Median was computed by adding upper and lower limits for each class and dividing by 2.